inherited, it rests with the embryologists to furnish a theory of physical transmission. On the other hand, the embryologists may show conclusively that such inheritance is impossible."

At the end of his address on acquired characters, Prof. Osborn observes that "it follows as an unprejudiced conclusion from our present evidence that upon Weismann's principle [the non-transmission of special individual variations] we can explain inheritance but not evolution, while with Lamarck's principle [the transmission of acquired variations], and Darwin's selection-principle, we can explain evolution, but not, at present, inheritance. Disprove Lamarck's principle, and we must assume there is some third factor in evolution of which we are now ignorant."

A totally different subject is taken up in the seventh lecture, by Prof. T. H. Morgan, on the relationships of the sea-spiders. In this it is considered that the Pycnogonida, as the group to which these curious creatures belong has been termed, come nearest to the Arachnida, both as regards many peculiarities of the adult and also of the various stages of development. After discussing the morphology of the peculiar "Pantopod" larva of these forms, and its relations to the "Trochophore" of the Annelids, and the "Nauplius" of the Crustaceans, the lecturer has some observations upon the initial differences in the development of various groups of animals which are of sufficient general interest to be quoted at length. He observes :—

> "If we remember that during the time in which the groups of Annelids and Crustacea have been evolved, the larval forms themselves have been acted upon in an increased degree, there seems every reason to believe that the young may have been much more acted upon and suffered far greater changes. On the other hand, when we see in such a group as the Vertebrates that in the higher forms the young have been removed to a large extent from the action of surrounding conditions —as, for instance, by being enclosed within a shell as in the Sauropsida, or retained within the uterus in Mammals —then can we understand why the young resemble each other more closely than do the adults, for the obvious reason that the adults have had to adapt themselves to more numerous external conditions, while the embryo has remained fixed. Indeed, this may be pushed a step further, it seems to me, and explains why such young retain the characteristics of lower forms, while the adults have lost such structures. This may be due to the young having been removed to a greater extent than the adults from a process of active selection. Hence, in such a group, when we say that the ontogeny tends to repeat the phylogeny, we mean that the embryos have retained more of the ancestral features than have the adults. But in such groups as the ones we are discussing—Annelids, Crustacea, &c.—we ought to expect, if what I have said be true, the reverse of what we find in such a group as the higher Vertebrates; viz. that the young forms diverge far apart, and the adults come nearer together."

Our remarks on the foregoing lectures have extended to so much greater length than we had at first intended, that space allows little more than the quotation of the headings of the three remaining ones; although neither fails in attracting as much interest as their predecessors. The eighth lecture is by Prof. S. Watase on "Caryokinesis"—a term which it may be well to explain is derived from κάρυον, a walnut, and is applied to a peculiar kind of nuclear cell-division, as met with in Cephalopods and Echinoderms. In the ninth lecture Prof. Howard Ayers gives us an elaborate dissertation on "The Ear of Man, its past, present, and future." The lecturer concludes that the ear of the higher Vertebrates is derived by the invagination of part of a system of canal sense-organs, like the lateral line of fishes; and he ventures to predict certain lines of modification which he considers will probably arise in the human ear with the course of time. The volume concludes with an article by Prof. W. Libbey, of Princeton College, on "Ocean Temperatures and Currents."

We have already expressed our high opinion of the volume before us as containing valuable *résumés* by specialists on many moot biological topics; but we cannot conclude without recording the pleasure and interest to which its perusal has given rise in ourselves, or without heartily commending it to the attention of our readers.

R. L.

PHYSICAL GEOGRAPHY FOR SCIENCE STUDENTS.

Elementary Physical and Astronomical Geography. Specially designed for Pupil-Teachers, Students in Training, and Science Students. By R. A. Gregory. With Original Illustrations. (London: Joseph Hughes and Co., 1891.)

THE general conception and arrangement of this volume are very good, and the same may be said of the detailed treatment of most of the subjects discussed. There is, however, great inequality in the author's work. The portions dealing with mensuration and astronomy are for the most part excellent, though there is sometimes a want of appreciation of the difficulties felt by beginners, and a consequent deficiency in the explanations given. The geological and meteorological parts are less thoroughly treated, while the chapter devoted to plants and animals is so imperfect that it had better have been altogether omitted. In case the work goes to a second edition, it will be as well to call attention to a few of the points where some alteration or further elucidation would be advisable.

At p. 21 the fact that the earth has been circumnavigated is given as a proof that it is not flat. But this is no proof at all; for if the earth were a flat disk, with the North Pole as its centre and the equator midway between the pole and the southern circumference—as represented by "Parallax" and other flat-earth men—circumnavigation might be performed exactly as at present.

The fact that degrees of latitude are longer near the poles than near the equator, although the polar axis is shorter than the equatorial, is often a stumbling-block to learners. It is, in fact, one of the paradoxes, and some half-century ago Mr. Von Gumpach published a pamphlet, and wrote letters to Prof. Airy and to the Astronomical Society, demonstrating, as he thought, that the earth is elongated at the poles—is, in fact, a prolate spheroid, because, the degrees being measurably longer at the poles, shows, he maintained, that the radius is there longer. Mr. Gregory takes no notice of this difficulty, which is a very real one, and requires some explanation in a text-book for learners.

© 1891 Nature Publishing Group

At p. 107 we have the causes which lead to the difference between solar and mean time accurately stated, and a table given of the equation of time at different periods of the year. But though the causes are stated, they are not explained, and many students will fail to see, without explanation, why the apparent motion of the sun is greatest at the solstices, and least at the equinoxes.

At p. 133, the cause of dawn and twilight is well explained, but the fact that the length of day itself, as measured by the time the sun is visible above the horizon, is also increased by refraction, is not referred to.

In the chapter on the atmosphere we have a statement which, though founded on a fact of physics, is erroneous in the form in which it is given. It is stated that "When water vapour is transformed into the liquid state, a certain amount of heat is liberated, and therefore rainfall must have a considerable effect in warming the air, and conveying heat to higher latitudes." This is quite correct, but the author goes on to say that "one gallon of rain gives out latent heat sufficient to melt 75 pounds of ice, or to melt 45 pounds of cast-iron, and every inch of rainfall is capable of melting a layer of ice upwards of 8 inches thick spread over the ground." Here, supposing the figures to be correct as regards the amount of heat given out during condensation, yet the latter part of the statement as it stands is incorrect, and very misleading. The heat of condensation is transferred to the cold current which causes the condensation high up above the surface of the earth, and does not remain in the rain, which therefore is not "capable of melting" any definite quantity of ice, since its temperature may be very little above the freezing-point when it reaches the earth. Water in freezing also parts with its latent heat of liquefaction, which goes to reduce the extreme cold of the air currents which froze the aqueous vapour, but no one would say that the snow brought this heat to the earth. The two cases are exactly parallel.

As illustrations of the ignorance or carelessness exhibited in the chapter on plants and animals, a few extracts will suffice. The characteristic plants of the Arctic zone are said to be "rhododendrons, lichens, and azaleas," while the vegetation of the torrid zone is thus described: "the palms, bananas, and other trees are densely packed, climbing vines entwine around their branches, and interlace with enormous tree-ferns and grasses." No doubt all these plants are found in the torrid zone, but the manner in which they are grouped shows that the description was not written by a person conversant with tropical vegetation. The lists of plants and animals given as characteristic of the different regions are always inadequate, and sometimes ludicrously erroneous: as when "plants yielding spices," and "bamboos," are given among the characteristic flora, and "numerous insects" among the fauna, of South America; "olives," "tobacco," "oranges," and "vines" as characteristic of the African flora; "hares" among the Australian fauna, the American "custard-apples" among the Oriental flora, while "grasses" appear as characteristic plants of Australia alone.

Among the less important errata for correction in a future edition are the following: at p. 50, in describing the noonday shadow at different seasons, the words "increase" and "decrease" are misplaced; at p. 170, "the Friendly Islands" are given as examples of conical isolated volcanic peaks; at p. 174, "the late Professor Darwin" is referred to; at p. 250 the dark heat-rays are said to be *reflected* from the earth's surface, instead of *radiated*, while, a few lines above, "radiation" is omitted as an important means of heating the atmosphere; and, at p. 280, the table gives "classes" instead of "genera" of Mammalia and birds.

In pointing out some deficiencies of Mr. Gregory's work, it must be remembered that many of the observations will apply equally to other works, some of them of considerable reputation; while the present volume is by no means without special merits. The chapter on the rotation of the earth and consequent phenomena is exceedingly good, as is the following one on its revolution. The account of eclipses and of the tides is also good, and well calculated to render these phenomena intelligible to learners. The chapters on the atmosphere and its movements are also clear and instructive, as are those on oceans and ocean currents. The numerous illustrations, though rather coarse, are clear, and elucidate some of the more difficult problems discussed; and if the author will carefully revise his work for another edition, it may be rendered a very useful and trustworthy guide to students and teachers.

OUR BOOK SHELF.

Whence comes Man; from "Nature" or from "God"? By Arthur John Bell. (London: Wm. Isbister, 1888.)

Why does Man Exist? By Arthur John Bell. (London: Wm. Isbister, 1890.)

In these volumes Mr. Bell brings an acute and ingenious mind to bear on matters of science and the philosophical questions to which the study of science leads. Unfortunately there are many indications that Mr. Bell has no thorough and adequate first-hand acquaintance with the branches of science concerning which he writes. And when the science is mere scissors-and-paste-work, the conclusions are not likely to have the value which attaches to those of even the humblest practical observer. The first volume deals chiefly with the writings and opinions of Mr. Herbert Spencer, Prof. Huxley, and others, and introduces incidentally some quaint notions concerning matters physical and metaphysical. In the second volume, apart from theological questions, with which it is not our province to deal, the main thesis is that the fundamental cause of evolution is psychological. Every cell of the metazoan body is the seat of an intelligence or life which is capable of being conscious, and is therefore a person; and when a given life multiplies and divides, it gives rise to another life like itself without being diminished. Thus is constituted a *cell-patriarchy*. But a patriarchy involves a patriarch; and the patriarch is found in the parent-cell from which all others are produced. At the first division of the fertilized ovum there is constituted a parent-cell and a child-cell (Mr. Bell does not tell us how to determine which is which). The parent-cell may produce other child-cells, and the child-cell give birth to grandchild-cells, and so on; but throughout all cell-division the patriarch parent-cell remains. When invagination has taken place, we may be sure that the position of the parent-cell is at the mouth of the gastrula, for though it has subordinated its children to itself and to its service, that service has to be paid for. Later, however, we find it safely ensconced in the *lamina terminalis* of the brain, whence it directs the

© 1891 Nature Publishing Group